KUMARAGURU
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Register Number: …….

B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2013)

Fourth Semester

AERONAUTICAL ENGINEERING

U13AET404: Aircraft Propulsion

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Propulsion system will develop maximum thrust when the ratio of the atmospheric pressure to the nozzle exit pressure (P_{atm}/P_{exit}) is _____.
   a) Equal to one b) less than one
   c) Greater than one d) ∞
2. Reversible adiabatic process is called as…….. process.
3. The primary purpose of the…….is to bring the air required by the engine from the free-stream condition to the fan or compressor with minimum total pressure loss.
   a) nozzle b) inlet
   c) turbine d) compressor
4. ……is a low-frequency, high-amplitude pressure oscillation, which occurs on a mixed compression inlet, the inlet will *"unstart"* and engine flameout is possible.
5. Ratio of rotor static enthalpy rise to stage static enthalpy rise is called ……
   a) degree of reaction b) degree of resonance
   c) combustion efficiency d) degree of stall
6. The function of a compressor is to…….

7. The percentage of theoretical air required for complete combussion is (where ϕ- equivalence ratio)

   a) (1-ϕ/100)
   b) $\frac{100}{\phi}$
   c) $\frac{(1-100)}{\phi}$
   d) 1- $\frac{100}{\phi}$

8. The actual fuel/air ratio divided by the stoichiometric fuel/air ratio is called…….
9. The purpose of the aircraft engine exhaust nozzle is to …….of exhaust gas.

   a) increase the velocity
   b) decrease the temperature
   c) increase the exit pressure
   d) Decrease the velocity

10. …….extracts kinetic energy from the expanding gases which flow from the combustion chamber.

PART B (10 x 2 = 20 Marks)

(Not more than 40 words)

11. Distinguish between two stroke and four stroke engine.
12. Write down the thrust equation of an air-breathing engine and define specific impulse.
13. What is the function of a diffuser?
14. Define buzz phenomenon in supersonic inlet.
15. Define slip factor.
16. Define ram recovery point.
17. Define combustion efficiency.
18. What is the function of an after burner?
19. Distinguish between impulse and reaction turbines.
20. Distinguish between over expanded and under expanded nozzles.

PART C (5 x 14 = 70 Marks)

(Not more than 400 words)

Q.No. 21 is Compulsory

21. A turbojet engine propels an aircraft at a Mach number of 0.8 in level flight at an altitude of 10 km. The data for the engine is given below:

Stagnation temperature at the turbine inlet = 1200 K

Stagnation temperature rise through the compressor = 175 K

Calorific value of the fuel = 43 MJ/kg

Compressor efficiency = 0.75

Combustion chamber efficiency = 0.975

Turbine efficiency = 0.81

Mechanical efficiency of the power transmission between turbine and compressor = 0.98

Exhaust nozzle efficiency = 0.97

Specific impulse = 25 seconds

Temperature and velocity of sound at the engine entry at an altitude of 10 km are 223.15 K and 299.6 m/s respectively. Assume the same properties for air and combustion gases.

Calculate: (a) Fuel-air ratio, (b) Compressor pressure ratio, (c) Turbine pressure ratio, (d) Exhaust nozzle pressure ratio, (e) Mach number of exhaust jet.

22. a) (i) Describe briefly various types of inlets used in jet propulsion systems. (7)

(ii) Illustrate briefly different modes of operation of supersonic inlets. (7)

(OR)

b) (i) Derive an expression for external deceleration ratio for subsonic inlets. (7)

(ii) Describe briefly the starting problems on supersonic inlets. (7)

23. a) (i) Explain briefly with a sketch the working principle of an axial flow compressor. (7)

(ii) Write short notes on, (i) compressor surging, (ii) compressor stall (7)

(OR)

b) (i) Explain briefly with a sketch the working principle of a centrifugal compressor. (7)

(ii) Construct a velocity diagram for an axial compressor and obtain important relations from the same. (7)

24. a) (i) Describe briefly the factors affecting the combustion chamber design. (6)

(ii) Explain the following terminologies: (i) Flame stabilization, (ii) Flame tube cooling, (iii) After burner, (iv) thrust augmentation. (8)

(OR)

b) (i) Describe briefly matching procedures for turbine and compressor. (7)

(ii) What are the limiting factors in gas turbine design? (7)

25. a) (i) Differentiate the impulse turbine from the reaction turbine. (7)

(ii) Explain briefly how the velocity triangles can be used to calculate the basic performance of a turbine stage. (7)

(OR)

b) (i) Describe briefly the design consideration of a convergent-divergent nozzle for getting optimum performance. (7)

(ii) Explain the condition of nozzle flow choking and describe briefly the nozzle operating characteristics for isentropic flow. (7)

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